

## SUBSTITUTION SHEET

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## Claims

1. An information processing system comprising:

plural information processing units each holding a local information block to express tabular data expressed as an array of records including an item and item values belonging to the item; and

a packet transmission path to connect the plural information processing units,

wherein the local information block includes a value list in which the item values are stored in order of item value numbers corresponding to item values belonging to a specific item, and a pointer array in which pointer values to indicate the item value numbers are stored in order of numbers to indicate a unique local order corresponding to the records, and the information processing unit is characterized in that each of the information processing units includes:

means for creating, based on the numbers to indicate the local order in the local information block, numbers to indicate a unique global order in all the plural information processing units;

means for transmitting the value list to another information processing unit through the packet transmission path;

means for receiving a value list from the another information processing unit through the packet transmission

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path; and

means for giving, by referring to an item value in the value list from the another information processing unit, a global order in all the plural information processing units to the item value in the value list in the local information block.

2. An information processing system comprising:

plural memory modules each having a memory, an interface, and a control device; and

a packet transmission path connecting interfaces of the adjacent memory modules,

wherein a memory of each of the memory modules holds an information block including a value list which is for expressing tabular data expressed as an array of records each including an item and an item value belonging to the item and in which item values are stored in order of item value numbers corresponding to the item values belonging to a specific item, and a pointer array in which pointer values to indicate the item value numbers are stored in a unique order of an ordered set array, and a global information block is formed of an aggregate of the information blocks held in the respective memories, and the information processing system is characterized in that

the control device of each of the memory modules includes: offset value storage means for holding an offset

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value to indicate that its own grasped information block, as a subset of the global information block, occupies which position in the pointer array;

global ordered set array creation means for creating, based on the offset value, a global ordered set array in the global information block;

packet transmission means for packeting its own value list of an item and transmitting it by using the transmission path between the adjacent memory modules;

packet reception means for receiving a packeted value list of another memory module by using the transmission path in parallel to packet transmission by the packet transmission means; and

order judgment means for determining an order, in the global information block, of the item value in its own value list of the item by referring to the received respective value list and for storing the order, in the global information block, of the item value into a global value number array relating to the item.

3. The information processing system according to claim 2, characterized in that the order judgment means is constructed to calculate the order in the global information block by adding a total sum of differences between the judged respective relative orders and the original order to the original order.

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4. The information processing system according to claim 2 or 3, characterized in that the order judgment means compares the transmitted packet and the received packet and deletes a duplicate value.

5. The information processing system according to any one of claims 2 to 4, characterized in that the control device of each of the memory modules includes:

flag array setup means for creating, with respect to an item to be retrieved, a flag array with a same size as the value list of the item and for giving a specific value to an inside of the flag array corresponding to an item value coincident with a retrieval condition;

retrieval condition judgment means for judging whether a record corresponding to a value in the ordered set array is coincident with the retrieval condition by specifying, with respect to the item to be retrieved, a value in the pointer array corresponding to a position indicated by the ordered set array and then by specifying a value in the flag array corresponding to a position indicated by the value in the pointer array; and

local retrieval means for storing a value of an ordered set coincident with the retrieval condition and a value of a corresponding global ordered set into a second ordered set array and a second global ordered set array,

wherein the packet transmission means uses the

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transmission path, packets the second global ordered set array and transmits it, the packet reception means uses the transmission path and receives a packetized second global ordered set array of another memory module,

there is further included second order judgment means for determining an order, in the global information block, of a value in its own global ordered set array by referring to the received respective second global ordered set array and for storing the order in the global information block into a third global ordered set array, and

an order of a record coincident with the retrieval condition is decided by a value of the third global ordered set array.

6. The information processing system according to any one of claims 2 to 5, characterized in that the control device of each of the memory modules includes

count-up means for creating, with respect to items to be tabulated, a logical coordinate array with a size obtained by multiplying sizes of value lists of the items and for acquiring the number of records for each set of item values of each item by counting up values of the logical coordinate array indicated by values in the ordered set array and corresponding to the sets of the values in the pointer arrays of the items to be tabulated,

wherein the packet transmission means uses the

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transmission path, and packets and transmits the logical coordinate array in which count-up has been performed by the count-up means, the number of records for each set of item values of each global item is stored in the logical coordinate array by sequentially executing, in each of the memory modules, the count-up of the same logical coordinate array and the transmission using the transmission path, and

in each of the memory modules, the packet reception means and the packet transmission means sequentially execute reception and storage of the logical coordinate array in which the count-up has been ended, and the transmission using the transmission path.

7. The information processing system according to claim 6, characterized in that the count-up means creates, with respect to items to be tabulated, a multi-dimensional count-up array with a size obtained by multiplying sizes of value lists of the items, acquires the number of records for each set of item values of each item by counting up values in the count-up array indicated by values in the ordered set array and corresponding to the set of values in the pointer arrays of the items to be tabulated, and arranges, in the logical coordinate array in which mapping to position in the count-up array is made, a value in the count-up array in accordance with the mapping.

8. The information processing system according to any

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one of claims 2 to 7, characterized in that the control device of each of the memory modules includes:

existence number array creation means for creating, with respect to an item to be sorted, an existence number array with a same size as a value list of the item and for arranging the number of values, to specify respective item values in the value list, of the ordered set array;

accumulated number array creation means for accumulating values in the existence number array, calculating an accumulated number to indicate a head position of a record having a corresponding item value at a time when the sort is performed in the memory module, and arranging the accumulated number in an accumulated number array; and

local sort means for creating a second global value number array, a fourth global ordered set array and a third ordered set array, arranging a global value number corresponding to the item value at a position indicated by the accumulated number in the second global value number array based on the accumulated number in the accumulated number array corresponding to an item value indicated by a value of the ordered set array, and arranging a value of the ordered set array and a value of the corresponding global ordered set array at a position indicated by the accumulated number in the third ordered set array and the fourth global ordered set array,

wherein the packet transmission means uses the

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transmission path, and packets and transmits at least the second global value number array, and the packet reception means uses the transmission path in parallel and receives a packeted second global value array of another memory module,

there is further included third order judgment means for storing an order, in the global information block, of a value in its own second global value number array into the fifth global ordered set array, and

an order of the sorted record is decided by the value of the fifth global ordered set array.

9. The information processing system according to claim 8, characterized in that the packet transmission means packets and transmits the second global value number array and the fourth global ordered set array by pairing a value of the second global value number array and a value of the fourth global ordered set array, the packet reception means receives the packeted second global value number array and fourth global ordered set array of another memory module, and

the third order judgment means judges an order by comparing, when a value of its own second global value number array and a value of the second global number array of another memory module are equal, values of the fourth global ordered set arrays forming a pair of the respective values.

10. The information processing system according to any one of claims 2 to 9, characterized in that the control device

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of the memory module includes a register group for use as the array, and an operation using the array is executed without accessing a memory.

11. An information processing method in an information processing system including plural information processing units each holding a local information block to express tabular data expressed as an array of records including an item and item values belonging to the item, and

a packet transmission path to connect the plural information processing units,

wherein the local information block includes a value list in which the item values are stored in order of item value numbers corresponding to item values belonging to a specific item, and a pointer array in which pointer values to indicate the item value numbers are stored in order of numbers to indicate a unique local order corresponding to the records, and

in each of the information processing units, the information processing method is characterized by comprising:

a step of creating, based on the numbers to indicate the local order in the local information block, numbers to indicate a unique global order in all the plural information processing units;

a step at which each of the information processing unit transmits the value list to another information processing unit

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through the packet transmission path;

a step at which each of the information processing unit receives a value list from the another information processing unit through the packet transmission path; and

a step at which each of the information processing units gives, by referring to an item value in the value list from the another information processing unit, a global order in all the plural information processing units to the item value in the value list in the local information block.

12. An information processing method in an information processing system including plural memory modules each having a memory, an interface, and a control device, and

a packet transmission path connecting interfaces of the adjacent memory modules,

wherein a memory of each of the memory modules holds an information block including a value list which is for expressing tabular data expressed as an array of records each including an item and an item value belonging to the item and in which item values are stored in order of item value numbers corresponding to the item values belonging to a specific item, and a pointer array in which pointer values to indicate the item value numbers are stored in a unique order of an ordered set array, and a global information block is formed of an aggregate of the information blocks held in the respective memories, and

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the information processing method is characterized by comprising:

in each of the memory module, an offset value storage step of holding an offset value to indicate that its own grasped information block, as a subset of the global information block, occupies which position in the pointer array;

a global ordered set array creation step of creating a global ordered set array in the global information block based on the offset value;

a packet transmission step of packeting its own value list of an item and transmitting it by using the transmission path between the adjacent memory modules;

a packet reception step of receiving a packeted value list of another memory module by using the transmission path in parallel to the packet transmission; and

an order judgment step of referring to the received respective value list and storing an order, in the global information block of the item value, of the item value in its own value list of the item into a global value number array relating to the item.

13. The information processing method according to claim 12, characterized in that the order judgment step includes a step of calculating the order in the global information block by adding a total sum of differences between the judged respective relative orders and the original order

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to the original order.

14. The information processing method according to claim 12 or 13, characterized in that at the order judgment step, the transmitted packet is compared with the received packet and a duplicate value is deleted.

15. The information processing method according to any one of claims 12 to 14, characterized by comprising: in each of the memory modules,

a flag array setup step of creating a flag array with a same size as the value list of the item and giving a specific value to an inside of the flag array corresponding to an item value coincident with a retrieval condition;

a retrieval condition judgment step of judging whether a record corresponding to a value in the ordered set array is coincident with the retrieval condition by specifying, with respect to an item to be retrieved, a value in the pointer array corresponding to a position indicated by the ordered set array and then by specifying a value in the flag array corresponding to a position indicated by the value in the pointer array;

a local retrieval step of storing a value of an ordered set coincident with the retrieval condition and a value of a corresponding global ordered set into a second ordered set array and a second global ordered set array;

a second packet transmission step of packeting the second global ordered set array and transmitting it by using the

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transmission path;

a second packet reception step of receiving a packeted second global ordered set array of another memory module by using the transmission path in parallel to the packet transmission; and

a second order judgment step of determining an order, in the global information block, of a value in its own global ordered set array by referring to the received respective second global ordered set array and storing the order in the global information block into a third global ordered set array,

wherein an order of a record coincident with the retrieval condition is decided by a value of the third global ordered set array.

16. The information processing method according to any one of claims 12 to 15, characterized by comprising: in each of the memory modules,

a count-up step of creating, with respect to items to be tabulated, a logical coordinate array with a size obtained by multiplying sizes of value lists of the items, and acquiring the number of records for each set of item values of each item by counting up values of the logical coordinate array indicated by values in the ordered set array and corresponding to sets of values in the pointer arrays of the items to be tabulated; and

a third packet transmission step of packeting and

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transmitting, by using the transmission path, the logical coordinate array in which the count-up has been performed,

wherein the number of records for each set of item values of each global item is stored in the logical coordinate array by sequentially executing, in each of the memory modules, the count-up step to the same logical coordinate array and the transmission step using the one transmission path, and

there are further included:

a third packet reception step of, in each of the memory modules, receiving and storing the logical coordinate array in which the count-up has been ended; and

a fourth packet transmission step of transmitting the received logical coordinate array by using the transmission path.

17. The information processing method according to claim 16, characterized in that in the count-up step,

with respect to items to be tabulated, a multi-dimensional count-up array with a size obtained by multiplying sizes of value lists of the items is created, the number of records for each set of item values of each item is acquired by counting up values in the count-up array indicated by values in the ordered set array and corresponding to the set of values in the pointer arrays of the items to be tabulated, and in the logical coordinate array in which mapping to position in the count-up array is made, a value in the count-up array

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is arranged in accordance with the mapping.

18. The information processing method according to any one of claims 12 to 17, characterized by comprising: in each of the memory modules,

an existence number array creation step of creating, with respect to an item to be sorted, an existence number array with a same size as a value list of the item, and arranging the number of values, to specify respective item values in the value list, of the ordered set array;

an accumulated number array creation step of accumulating values in the existence number array, calculating an accumulated number to indicate a head position of a record having a corresponding item value at a time when the sort is performed in the memory module, and arranging the accumulated number in an accumulated number array;

a local sort step of creating a second global value number array, a fourth global ordered set array and a third ordered set array, arranging a global value number corresponding to the item value at a position indicated by the accumulated number in the second global value number array based on the accumulated number in the accumulated number array corresponding to an item value indicated by a value of the ordered set array, and arranging a value of the ordered set array and a value of the corresponding global ordered set array at a position indicated by the accumulated number in the third ordered set array and

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the fourth global ordered set array;

a fifth packet transmission step of packeting and transmitting at least the second global value number array by using the transmission path;

a fourth packet reception step of receiving a packeted second global value array of another memory module by using the transmission path in parallel to packet transmission; and

a third order judgment step of storing an order, in the global information block, of a value in its own second global value number array into the fifth global ordered set array,

wherein an order of the sorted record is decided by the value of the fifth global ordered set array.

19. The information processing method according to claim 18, characterized in that

at the fifth packet transmission step, a value of the second global value number array and a value of the fourth global ordered set array are paired, and the second global value number array and the fourth global ordered set array are packeted and transmitted,

at the fourth packet reception step, the packeted second global value number array and fourth global ordered set array of another memory module are received, and

at the third order judgment step, an order is judged by comparing, when a value of its own second global value number array and a value of the second global number array of another

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memory module are equal, values of the fourth global ordered set arrays forming a pair of the respective values.

20. A program for an information processing system including plural information processing units each holding a local information block to express tabular data expressed as an array of records including an item and item values belonging to the item, and

a packet transmission path to connect the plural information processing units,

wherein the local information block includes a value list in which the item values are stored in order of item value numbers corresponding to item values belonging to a specific item, and a pointer array in which pointer values to indicate the item value numbers are stored in order of numbers to indicate a unique local order corresponding to the records, and

the program causes each of the information processing units to realize:

a function of creating, based on the numbers to indicate the local order in the local information block, numbers to indicate a unique global order in all the plural information processing units;

a function of transmitting the value list to another information processing unit through the packet transmission path;

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a function of receiving a value list from the another information processing unit through the packet transmission path; and

a function of giving, by referring to an item value in the value list from the another information processing unit, a global order in all the plural information processing units to the item value in the value list in the local information block.

21. (Amended) An information processing system comprising:

plural information processing units each including a memory and a control device,

wherein the memory of each of the information processing units holds tabular data expressed as an array of records each including an item and an item value belonging to the item,

global tabular data is formed of an aggregate of tabular data held by respective memory modules, and the information processing system is characterized in that

each of the information processing units includes:

a local ordered set array containing values indicating local orders of the respective records in the information processing unit;

a global ordered set array containing values indicating orders of the respective records in the global tabular data; and

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record extraction means for specifying a value in the global ordered set array in accordance with an instruction to specify an order received by the control device, for specifying a value in the local ordered set array, a position of said value in the local ordered set array being consistent with that of the value in the global ordered set array, and for extracting the record indicated by the value n the local ordered set array.

22. (Amended) The information processing system according to claim 21, characterized in that the information processing unit is adopted such that,

in order to reflect a sort order in the information processing unit, in case that the values in the local ordered set array are exchanged,

in the global ordered set array, the value indicating the order is rearranged to indicate a sort order, in the global tabular data, of the record indicated by the value in the another ordered set array.

23. The information processing system according to claim 21, characterized in that the information processing unit rearranges the value indicating the order to indicate the sort order, in the global ordered set array, of the record sorted in the information processing unit.

24. The information processing system according to claim 21, characterized in that a memory of each of the information processing units holds

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an information block including a value list which is for expressing tabular data expressed as an array of records each including an item and an item value belonging to the item and in which the item values are stored in order of item value numbers corresponding to item values belonging to a specific item, and a pointer array in which pointer values to indicate the item value numbers are stored in a unique order of an ordered set array, and

a global information block is formed of an aggregate of the information blocks held in the respective memories.

25. An information processing system comprising plural information units each including a memory and a control device,

wherein a memory of each of the memory modules holds an information block including a value list which is for expressing tabular data expressed as an array of records each including an item and an item value belonging to the item and in which item values are stored in order of item value numbers corresponding to the item values belonging to a specific item, and a pointer array in which pointer values to indicate the item value numbers are stored in a unique order of an ordered set array, and a global information block is formed of an aggregate of the information blocks held in the respective memories, and the information processing system is characterized in that

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the information processing unit includes:

a global value number array to contain a value indicating an order of an item value in a global information block; and item value extraction means for specifying a value in the global value number array in accordance with an instruction to specify an order received by the control device and for extracting an item value in the value list indicated by the value.